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ABSTRACT

The effectiveness of a Training Extension Course (TEC) as a means of increasing the Military Occupational Specialty (MOS) proficiency of Army personnel was evaluated. TEC was implemented by the Combat Arms Training Board using sound/slide as the basic media for 56 lessons. Training material relevant to MOS 11B40, Light Weapons Infantryman, was developed by various departments within the U.S. Army Infantry School and distributed to active Army and National Guards units. Analysis of the MOS 11B40 Evaluation Test results showed that 11B40 personnel with TEC material available scored higher on the individual weapons section of the test than personnel not using TEC materials. Units where TEC use was extensive rather than limited achieved the greatest increase in test scores. Among the major factors influencing the outcome of the TEC evaluation were command emphasis, ongoing training programs, verbal ability, and uneven quality and distribution of certain TEC lessons within a particular test area. Appendices include a description of the individual learning carrel with diagrams, a list of TEC lessons available to the units during testing, and the mode of study questionnaire. (Author/CMV)

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TEST AND EVALUATION OF TRAINING EXTENSION COURSE (TEC)

by

T.O. Jacobs
and
Richard A. Hardy,Jr.

Human Resources Research Organization
300 North Washington Street
Alexandria, Virginia 22314

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This project was intended primarily to evaluate the effectiveness of a Training Extension Course (TEC) as a means of increasing the Military Occupational Specialty (MOS) proficiency of Army personnel. TEC (utilizing sound/slide as the basic media for 56 lessons) was implemented by the Combat Arms Training Board. Training material relevant to MOS 11B40 (Light Weapons Infantryman) was developed by various departments within the U.S. Army Infantry School and distributed to Active Army and National Guard

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Units. Analysis of MOS 11B40 Evaluation Test results showed that 11B40 personnel with TEC material available scored significantly higher on Major Area One (Individual Weapons) of the test than 11B40 personnel who did not use TEC materials. Those units (e.g., National Guard units) where TEC use was extensive rather than limited achieved the greatest increase in MOS 11B40 Evaluation Test scores. Among the major factors influencing the outcome of the TEC evaluation were: command emphasis, ongoing training programs, verbal ability,and uneven quality and distribution of certain TEC lessons within a particular MOS 11B40 Evaluation test area.

MILITARY PROBLEM

In an effort to achieve more dynamic training in Combat Arms units, the Chief of Staff of the Army, on 30 June 1971, directed the decentralization of training management to battalion level and lower. To help unit commanders carry out this increased responsibility, the Board for Dynamic Training was established at Fort Benning, Georgia. During its existence, the Board identified several critical problem areas and suggested potential solutions. The task of implementing these solutions was assigned to the Combat Arms Training Board (CATB), which succeeded the Board for Dynamic Training.

One problem area was the lack of a link between the Service schools, with their enormous content and training expertise, and the units, with their increased responsibility to conduct training. This was especially crucial because much training within units had been found to be individual training; that is, unit commanders had been confronted with the problem of maintaining *individual* Military Occupational Specialty (MOS) competence as a prerequisite to developing and conducting challenging *unit* training. Without a minimum level of individual skills, unit training was not profitable; however, the requirement to develop training for maintaining individual skills was virtually monopolizing the commander's attention and pre-empting his use of available time.

The Board for Dynamic Training identified as a major initial step the development of carefully engineered training materials, which would be prepared by Service schools and used within units in an audio-visual mode. To be known as Training Extension Courses (TEC), these materials would enable the commander to maintain individual proficiency in selected subject areas with a minimum of time and effort expended at the unit level. The present pilot study was designed to provide an initial evaluation of effectiveness of this concept.

APPROACH

At the time the TEC concept was being implemented, planning was also under way for the 1972 MOS 11B40 (Light Weapons Infantryman) Proficiency Pay Testing. Providing TEC training for soldiers taking the MOS 11B40 tests seemed a useful approach to testing TEC effectiveness; MOS Test scores would be used as a criterion of effectiveness.

Committees within the U.S. Army Infantry School developed both TEC training materials and Proficiency Test items. A total of 56 TEC lessons was prepared, covering four major MOS Test areas. Test subjects for the evaluation were soldiers with a primary MOS of 11B40, who were rostered for evaluation during November 1972.

Within divisions and separate brigades, the evaluation design called for identifying certain battalions as TEC battalions, others as Control battalions. TEC battalions were issued all TEC materials, plus all materials given to the Control groups. Control battalions were given all preparatory materials and media available to the TEC battalions, except for the TEC materials.

A third Control group was drawn after-the-fact from Army-wide takers of the MOS Test. This Control group was needed to insure that the battalion Control groups accurately represented the Army, so that the comparison between TEC and Control battalions could be applied to the Army as a whole.

To examine the possibility that MOS Test scores were significantly affected by verbal ability, the scores of the NCOs taking the test were correlated with their Verbal English (VE) scores, as obtained from the General Technical Aptitude Area (GT) of the Army Classification Battery recorded on their individual record jackets.

MAJOR FINDINGS

(1) Correlation of MOS Test scores with VE scores was lower than expected (on the order of .2 to .3), but still statistically significant. Consequently, VE was used as an additional control during the analysis of evaluation results.

(2) Analysis of the relationship between TEC use and verbal ability suggests that the TEC materials did not completely reach the target population (low verbal ability individuals). For example, low users of TEC materials tended to be units with low verbal ability (82d Division, mean VE = 98.6; 2d Division, mean VE = 93.4) and high users of TEC materials were generally units with high verbal ability (30th Division, mean VE = 113.0; 71st Brigade, mean VE = 114.5; 73d Brigade, mean VE = 118.0).

(3) A comparison of the individual MOS Test scores of TEC experimental battalions and Control battalions showed that performance was significantly better in Major Area One (Individual Weapons) for those test subjects to whom TEC materials had been available. This superiority existed when verbal ability was used as a control as well as when it was not. There was a trend for TEC subjects to score higher in Major Area Three (Tactics) as well. However, this was not consistent.

(4) An analysis of lessons studied by TEC subjects did not demonstrate that these subjects had a greater chance of correctly answering test questions covered by TEC materials than questions not so covered.

(5) However, the amount of studying correlated significantly (around .3) with the MOS score at an individual level. This correlation remained significant (about .2) when VE was controlled. This conflicts with the preceding finding and suggests that there may have been differences between battalions in the manner in which TEC materials were used, and that these differences influenced the outcomes of the evaluation fairly strongly.

(6) At the unit level also there was a significant relationship between the use of TEC materials and performance on the MOS Test. The rank order correlation between the average number of lessons studied by battalion and the average MOS Test score by battalion was .88—a significant figure. Examination of the average number of lessons studied showed an extreme range of use of TEC materials. In one unit, all NCOs studied all TEC materials. This battalion also scored highest on the MOS Test, on the average. At the other extreme, two battalions studied an average of 1.3 TEC lessons. These two battalions were tied for last in the MOS Test standings. In short, where TEC use was not high, performance on the MOS Test was not high either. While these relationships do not *prove* that TEC use *caused* higher MOS test scores, that possibility is certainly suggested.

(7) Possible factors leading to the non-use of TEC materials were suggested: lack of emphasis within the unit, competing programs and priorities, and lack of time during the duty day. Any or all of these factors would be sufficient to decrease use of TEC materials.

CONCLUSIONS

(1) The evaluation demonstrated that MOS Test performance was higher in units to which TEC materials were available, and which at the same time reported high use of TEC materials. This suggests that TEC materials were useful in preparing for the MOS Test.

(2) Analysis of both the MOS Test and the TEC materials suggested that a penalty was paid for the urgent time pressures imposed during the initial implementation of the TEC concept. Recommendations for improving material development and pretesting procedures are included in the body of the report.

PREFACE

This report describes activities performed by the Human Resources Research Organization (HumRRO) in testing and evaluating a Training Extension Course (TEC) featuring audio-visual materials. The objective was to determine how effective the TEC method was in increasing the Military Occupational Specialty (MOS) proficiency of Army personnel.

The research was conducted as part of Work Unit CATB by HumRRO Division No. 4, Fort Benning, Georgia, under the direction of Dr. T.O. Jacobs, Division Director. Dr. James A. Caviness supervised the test and evaluation of TEC. Mr. Clarence J. Bushaw and Mr. Richard A. Hardy, Jr., developed the data collection instruments and the analysis plan.

The Combat Arms Training Board was primarily responsible for coordinating the various military activities in the project. COL John W. Seigle was the President of the Board, and the Board's activities for the project were directed by LTC William J. Hilsman and LTC Robert P. Dirmeyer. MAJ Russell W. Andrews, MAJ Jim L. Madden, and MAJ Billie F. Moore coordinated the data collection effort.

The U.S. Army Infantry Human Research Unit, commanded by LTC Willys E. Davis, provided 1LT John C. Nicholas, 2LT Thomas Fitzgerald, SP5 Thomas M. Meierhofer, SP5 David Ramm, SP5 James M. Tripp, SP4 Raymond C. Singleton, SP4 Carl C. Cordova, SP4 Lonsworth E. Smith, and SP4 Ennis R. Brooks as military support.

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Meredith P. Crawford
President
Human Resources Research Organization

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Test and Evaluation of Training Extension Course (TEC)

INTRODUCTION

BRIEF HISTORY

The U.S. Army field commanders for many years have been responsible for training personnel and units. However, they have not always had access to the resources necessary to accomplish these tasks. In an effort to achieve more dynamic training in combat arms units, the Chief of Staff of the Army, on 30 June 1971, directed that all detailed training management tasks be decentralized to battalion level and lower. To develop better support for training, the Chief of Staff directed the formation of the Board for Dynamic Training at Fort Benning, Georgia, to investigate methods of assisting unit commanders to conduct exciting, meaningful, and rewarding training.

During its tenure, the Board identified a number of problem areas which appeared to be obstacles to the development of dynamic training within Active Army and Reserve Component units. As one solution, the Board recommended that an organization be established to increase both the professionalism of junior leaders and the dynamism of training within Active Army and Reserve Component units. Accordingly, the Combat Arms Training Board (CATB) was established, with the primary mission of developing and placing into action new and innovative training concepts.

However, innovation and newness in themselves are no guarantee of effectiveness. To ensure that new techniques would indeed be effective, CATB requested HumRRO assistance to measure their impact on training prior to full-scale implementation. This report presents the results of one such evaluation.

MILITARY PROBLEM

Unit commanders have the perennial requirement of conducting individual instruction within their units to insure that assigned personnel have adequate skills to perform unit missions. This training requirement may be of such magnitude that there is little remaining time or energy for the development of challenging *unit* training, though unit training is a more central responsibility for the commander than the training of individuals. A further difficulty is that the unit commander may have few really effective resources for conducting such individual training. It is evident that training materials are effective only to the extent that they are readily available to the soldier, and easily understandable when obtained. Commanders often encounter problems in both these areas.

First, much of the MOS-relevant reference material is difficult for the individual soldier to comprehend and use, mainly because of the techniques used to present information. Some problem areas in written materials have been:

- Irrelevant subject matter (too much nice-to-know information and not enough need-to-know information).
- Too many source documents (e.g., 15 field manuals covering a single subject area).
- Inadequate formatting of materials (not designed to facilitate job application use).
- High reading difficulty level (as many as six to eight grade levels too high for optimum use of materials).

Second, MOS-relevant material may be difficult to obtain in the unit. The supply of field manuals and technical manuals at company or battalion level is often limited. Even when this is not the case, the soldier may be required to travel to a central location to obtain manuals, which is in itself a demotivator.

A potential solution to this problem is the use of individualized instruction that can be administered at the unit level using programmed texts and audio-visual devices. The concept would be implemented through the development of Training Extension Courses (TEC), using multimedia equipment and programmed learning materials developed by U.S. Army branch schools and distributed to troop units. Thus, the TEC concept is designed to assist small-unit commanders by giving them direct access to the training expertise that exists in the Combat Arms Schools, and by giving the individual soldier ready access to relevant, effective, and interesting audio-visual self-paced instruction in MOS proficiency subjects.

Overall, the evaluation of this concept was directed at assessing the effectiveness of the TEC medium as a means of increasing MOS proficiency.

RESEARCH PROBLEM

The TEC concept was evaluated in the context of preparing for the annual 11B40 MOS Proficiency Test. This appeared to be a particularly suitable vehicle because of CATB interest in upgrading the quality of such proficiency tests, in addition to providing quality preparation for them. The research effort was directed toward the development of evaluation criteria, setting up an appropriate evaluation design, and conducting the evaluation effort.

METHOD

SUBJECTS

Test Subjects

The subjects were soldiers possessing MOS 11B40 (Light Weapons Infantryman) as their primary (P) MOS, in pay grades E-5, -6, or -7, and rostered for evaluation during November 1972. Divisions/brigades furnishing subjects for the evaluation of TEC were the 82d Airborne Division, 2d Armored Division, 4th Infantry Division (Mech), 30th Infantry Division (Mech), 73d Infantry Brigade, and 71st Airborne Brigade. The Active Regular Army (RA) units were the first three listed, whereas the last three were National Guard (NG) units.

Army-Wide Sample

The Army-wide (AW) sample was composed of Regular Army individuals with MOS 11B40 as their primary MOS and National Guard individuals with MOS 11B40 as their duty MOS. Pay grades E-4, -5, -6, and -7 of the Regular Army sample were randomly selected (every 20th individual within a pay grade) from the total available population (N = 9,069). The Regular Army sample thus totaled 474, with the frequency of individuals by pay grade corresponding to the larger Regular Army sample: (a) 46 E-4s, (b) 114 E-5s, (c) 224 E-6s, and (d) 90 E-7s. Excluding the E-4s, the percentage by pay grade was: (a) 27% E-5s, (b) 52% E-6s, and (c) 21% E-7s. All available National Guard

11B40s (N = 771) were included in the Army-wide sample. The comparisons between the Army-wide sample and the TEC Control groups were made with scores for the E-5 to E-7 pay grades.

MATERIALS

Audio-Visual Equipment (Hardware)

After considerable examination of options available, with special emphasis on problems of possible Army-wide implementation, the medium chosen for the initial TEC material was an audio-visual sound/slide package. The hardware consisted of the following:

(1) Recorder/programmer (cassette tape recorder designed for use in an electronically synchronized sound/slide presentation).
(2) Play-back unit (cassette tape player designed for use with a pre-programmed electronically synchronized sound/slide presentation).
(3) Responder (a testing device that enables a student to record answers to questions displayed during the course of a programmed lesson).
(4) Headset.
(5) Carrying case.
(6) Dust cover.
(7) Auxiliary speaker (for use during group instruction).
(8) Slide Projector (Carrousel Projector designed for use in an electronically synchronized sound/slide presentation).
(9) Screen, rear projection.
(10) Visual-maker kit (enables unit to produce its own slides).

Appendix A shows the sound/slide equipment arranged for presenting a TEC lesson.

TEC Lessons (Software)

Generally, a software package was composed of (a) recorded and programmed audio cassettes, and (b) supporting 35mm color slides, and lesson plans for presenting the material via conventional lecture or practical application.

There were 56 TEC lessons (approximately 119 hours of instruction) covering four major MOS Test areas. Generally, a TEC lesson covered a specific subject area (e.g., Night Vision Devices) within one of the four major areas. A list of the TEC lessons furnished to units is shown in Appendix B.

MOS 11B40 Evaluation Test (ET)

The MOS Evaluation Test (ET 12 - 11B40, Light Weapons Infantryman, MOS Code 11B40) was used to measure the MOS proficiency of TEC participants and controls. The scores derived from this test were as follows: (a) Total (sum of four major area scores), (b) Individual Weapons (Major Area One), (c) Crew-Served Weapons (Major Area Two), (d) Tactics (Major Area Three), (e) Field Activities (Major Area Four), and (f) Right and Wrong scores from individual questions. For purposes of this report, the first five scores were designated as the MOS 11B40 Evaluation Test (ET) areas.

MOS 11B40 Evaluation Test Report

The Validation Feeder Data Report furnished the MOS 11B40 Evaluation Test scores. The report grouped TEC and non-TEC participants by battalion. Each individual was identified by his last name, part of his first name, SSAN, and pay grade. The scores

presented on the report were (a) the MOS 11B40 Evaluation Test score, (b) the four major area scores, and (c) the individual's response to each test question.

VE Ability

Part of the evaluation effort was devoted to identifying and minimizing the effect of factors that might otherwise have extraneously influenced the outcomes of the test. One such factor was verbal ability. To control for this factor, a measure of verbal ability was needed. The one chosen was the Verbal English (VE) score from the General Technical Aptitude Area (GT) of the Army Classification Battery. VE scores were obtained from DA Form 20 (Enlisted Qualification Record).

Mode of Study

Study measures of the 56 TEC lessons available to all sound/slide units were obtained from a Mode of Study Questionnaire (see Appendix C). This questionnaire contained five study questions, plus the identification of the TEC lesson studied.

DESIGN

Generally, the evaluation of TEC took the form of a TEC experimental group (sound/slide) versus Control group (no sound/slide) design. The sound/slide group was composed of subjects who received an audio-visual presentation of MOS-relevant material (see Appendix A for illustration of apparatus). The Control group was composed of subjects who did not have the audio-visual materials, but had to rely on other study aids, such as technical manuals, field manuals, and *Six Roads to Success* (11B MOS Handbook, a study guide for Army personnel). The number of subjects by pay grade and unit for each group is shown in Table 1.

One-way analysis of covariance (VE score the covariate) and one-way analysis of variance were used to test the differences between groups. The analysis of variance used all available subjects. The analysis of covariance excluded subjects from the 4th Infantry Division because VE scores were not available for one of the control units of that division. Single comparisons (two levels) with the analysis of variance and/or analysis of covariance were performed for (a) all units combined, (b) Active Army versus National Guard, and (c) division/brigade. To assess differences between divisions/brigades, one-way analysis of covariance (four levels) was used.

PROCEDURE

Development of TEC

The MOS 11B40 material was developed by Infantry Officer Advanced Course students from the U.S. Army Infantry School working with a faculty advisor in each subject area. The students prepared draft lessons and designed the slide-tape programs. The Infantry School department directors in coordination with the Director of Instruction were responsible for the final development of the TEC lessons. The Director of Nonresident Instruction was the TEC Lesson Coordinator.

Administration of TEC in the Field

TEC project officers or representatives from the TEC units attended an orientation held at Fort Benning, Georgia, on 24-26 April 1972. At that time, they were familiarized

Table 1

Pay Grade and Unit Distribution of Subjects Participating in the TEC Evaluation

Group	Unit	Battalion	Pay Grade			Total
			E-5	E-6	E-7	
TEC	82d	2d BN, 325th Infantry	30	29	2	61
Experimental		2d BN, 508th Infantry	54	23	5	82
(Sound/Slide)		2d BN, 504th Infantry	30	21	0	51
		All	114	73	7	194
	4th	2d BN, 8th Infantry	16	5	0	21
		1st BN, 11th Infantry	5	6	1	12
		All	21	11	1	33
	2d	1st BN, 41st Infantry	18	19	0	37
		2d BN, 50th Infantry	9	7	2	18
		All	27	26	2	55
	30th (NG)	1st BN, 119th Infantry	31	5	0	36
	71st (NG)	2d BN, 143d Infantry	14	3	3	20
	73rd (NG)	1st BN, 166th Infantry	27	9	5	41
Control	82d	2d BN, 505th Infantry	3	5	3	11
(No Sound/		1st BN, 508th Infantry	15	19	6	40
Slide)		All	18	24	9	51
	4th	1st BN, 10th Infantry	9	13	0	22
	2d	2d BN, 41st Infantry	7	4	1	12
		1st BN, 50th Infantry	7	12	3	22
		All	14	16	4	34
	30th (NG)	1st BN, 118th Infantry	24	5	0	29
		1st BN, 120th Infantry	22	7	2	31
		All	46	12	2	60
	71st (NG)	1st BN, 143rd Infantry	16	5	0	21
		3d BN, 143rd Infantry	13	5	4	22
		All	29	10	4	43

with the TEC program and were shown how to operate TEC hardware (e.g., individual learning carrels at company or battalion level). Upon completion of the TEC orientation, the unit representatives returned to their units to start use of the TEC hardware and software. The TEC material was distributed to the units after the orientation.

Study Measures

Information as to TEC lessons used was obtained on a Mode of Study Questionnaire. Each division/brigade assigned either one or two project officers, depending on the number of TEC battalions in the division/brigade, who were responsible for collecting the questionnaire data. As each individual completed a TEC lesson, he completed the Mode of Study Questionnaire and gave it to the project officer, who forwarded the questionnaires to HumRRO.

Evaluation Test Scores

The following steps were used in obtaining the MOS 11B40 Evaluation Test scores from the U.S. Army Enlisted Evaluation Center and preparing them for analysis:

(1) A data retrieval team from CATB visited each unit following the November testing of the MOS 11B40 personnel. The test officer in charge of administering the MOS 11B40 Evaluation Test provided the CATB representative with the completed tests, which were then hand carried to the Evaluation Center.

(2) Prior to scoring, the tests were checked for accuracy; any irregularities in the test answer sheets (e.g., lack of proper identification) resulted in rejection of the test.

(3) The tests from the TEC units were identified separately from other incoming tests and were scored prior to the normal processing of these tests.

(4) The Validation Feeder Data Report listing all individuals was sent to HumRRO.

(5) Upon receipt of the Validation Feeder Data Report, military personnel from the Infantry School's Human Research Unit identified the TEC participants on the report from previously developed rosters. Individuals not required to take the MOS 11B40 Evaluation Test were identified and were eliminated from the analysis. The Evaluation Center provided a list that identified 11B40 personnel required to take the MOS Evaluation Test, as well as those not required to do so. The subjects considered for analysis were those individuals who were on both the Validation Feeder Data Report and the rosters.

TEC Lessons and the MOS 11B40 Evaluation Test

The relationship between the content of individual TEC lessons and the MOS 11B40 Evaluation Test was obtained through the Office of Doctrine Development, Literature and Plans (ODDLP), the Infantry School. The objective was to determine which MOS Test questions were covered by which TEC lessons, and how many times any given test question was covered by the entire series of TEC lessons. All 125 questions were found to be covered by TEC lessons, although some were covered more often than others.

Data for Analysis

The U.S. Army Infantry Human Research Unit helped organize the data for analysis. For each TEC participant, the following data were available:

(1) VE scores (raw).
(2) Total MOS 11B40 Evaluation Test Score (raw and standard).
(3) Test Major Areas One through Four (raw and standard).
(4) Total number of lessons studied (raw).
(5) TEC lessons studied.
(6) Number of MOS questions related to TEC lessons studied.
(7) Pay grade.
(8) Unit.

The VE scores for the 4th Infantry Division were received too late to be included in the analyses.

RESULTS

IDENTIFICATION OF CONFOUNDING VARIABLES

The analyses performed in this section were intended to determine whether statistical controls (e.g., for VE ability) would be needed in the remaining analyses.

VE Ability and the MOS 11B40 Evaluation Test

The relationship between the MOS Test total score and the VE score was examined by computing a Pearson product-moment correlation. The correlations between VE score and total MOS Test score are shown in Table 2 for (a) all subjects in all units, (b) TEC experimental and Control groups within each division/brigade, and (c) all subjects within each unit. Only five correlations failed to reach significance at the .05 level. This demonstrates, as might have been expected, that the MOS Test scores are not independent of the ability measured by the VE Test.

The VE score consequently was used as a covariate in a number of subsequent analyses to control for verbal ability.[1]

Table 2

Correlations Between Verbal English (VE) and 11B40 Evaluation Test Total Score

		Group								
		TEC			Control			Combined		
Combination	Unit	*r*	*df*	*p*	*r*	*df*	*p*	*r*	*df*	*p*
Individual	82	+.32	134	.01	+.42	43	.01	+.32	179	.001
Units	2	+.33	27	.10	+.42	27	.05	.37	56	.01
	4	+.39	24	.05	--	--	--	--	--	--
	30	+.42	29	.05	+.21	58	NS	+.27	89	.01
	71	+.27	17	NS	+.39	36	.05	+.25	55	.10
	73	+.59	31	.001	--	--	--	--	--	--
All Units	82,2 30,71	+.29	213	.01	+.12	170	NS	+.19	385	.01

Division/Brigade Differences

In addition to differing in average verbal aptitude (VE), it was considered possible that TEC experimental and Control battalions might differ on other variables as well. Some of the areas in which differences could exist were unit strength, mission priorities, location of personnel in relation to the location of TEC or other materials, and unit training priorities (including the possibility of unit training for the MOS Test).

Accordingly, MOS Test scores were compared, across participating units, using analysis of covariance with VE as the covariate, to determine whether the units differed in performance on the test. An analysis was done for each of the four subareas in the test and for total scores. The experimental battalions and the Control battalions were compared separately, for a total of 10 analyses. Each analysis yielded a significant ($p<.001$) result, showing that there were definite MOS Test differences between units within experimental conditions.

The exact reasons for these differences are not known. However, it is clear that TEC battalions differed from one another in performance not only on the total MOS Test score, but also on the individual sections. The same was true for the Control battalions.

[1] Without this control, VE differences between units, which might have occurred by chance, could have affected the outcome of the evaluation.

Since these differences might have obscured differences between TEC and Control battalions in subsequent analyses, standard scores (mean of 50 and standard deviation of 15) were computed within each of the participating divisions/brigades. These scores constitute the basis for most of the comparisons reported in the following sections.

Control Group and Army-Wide Sample

In evaluating the TEC program, there was concern that information might have spread from TEC battalions to Control battalions. Some battalions were in close proximity, a condition that would facilitate such a spread of information and contaminate the evaluation findings. Accordingly, the performance of Control battalions was compared with the performance of an Army-wide sample furnished by the U.S. Army Enlisted Evaluation Center. In this comparison, only Regular Army personnel were used because National Guard personnel in the Army-wide sample had 11B40 as a duty MOS, while those in the TEC Control sample had 11B40 as a primary MOS.

Means and standard deviations of the four subarea scores and total scores on the MOS Test by pay grade and for all pay grades combined are shown in Table 3. For each of the comparisons indicated in the table, a *t* test was performed. None of these tests yielded a significant result. It therefore was concluded that TEC Control group performance did not differ from that of the Army-wide samples and that the TEC Control group was a suitable standard against which to compare TEC experimental groups.

Table 3

MOS Test Scores for Control and Army-wide Groups

		Army-wide		Control	
Pay Grade	MOS 11B40 ET Area	Mean Score (Number Correct)	SD (Number Correct)	Mean Score (Number Correct)	SD (Number Correct)
E-5	Total Score	62.8	12.9	62.3	12.0
	Major Area One	13.0	3.7	12.1	3.2
	Major Area Two	14.4	3.7	14.1	3.7
	Major Area Three	14.7	3.5	14.1	3.7
	Major Area Four	20.8	4.9	22.0	4.0
E-6	Total Score	72.0	13.2	71.1	14.0
	Major Area One	14.6	3.7	13.9	3.5
	Major Area Two	16.4	3.8	16.5	4.2
	Major Area Three	17.1	3.7	16.5	3.8
	Major Area Four	24.0	5.0	24.2	5.1
E-7	Total Score	79.5	14.3	83.9	14.4
	Major Area One	15.5	4.6	17.7	3.0
	Major Area Two	18.2	4.1	18.8	5.5
	Major Area Three	18.8	3.2	20.8	4.1
	Major Area Four	26.9	5.4	26.6	4.8
Combined	Total Score	71.1	14.5	69.3	14.8
	Major Area One	14.3	4.0	13.7	3.7
	Major Area Two	16.3	4.0	15.8	4.4
	Major Area Three	16.8	3.8	16.1	4.3
	Major Area Four	23.7	5.5	23.7	4.9

TEC EXPERIMENTAL-CONTROL COMPARISONS

All Units Combined[1]

The effectiveness of the TEC sound/slide materials was evaluated through direct comparison between TEC experimental and Control subjects. In this part of the analysis, comparisons were made not only for total test scores but also for the four subarea scores. Because individuals are combined from all units, standard scores were used. Means, standard deviations, adjusted means, and *F* ratios for the analyses done are shown in Table 4.

Table 4

Comparison of TEC Experimental and Control Group Performance, All Units Combined

Type of Analysis	MOS 11B40 ET Area	Group						High Group	*F* ratio	*p*
		TEC Experimental (Sound/Slide)			Control (No Sound/Slide)					
		Mean	SD	Adj. Mean[a]	Mean	SD	Adj. Mean[a]			
Analysis of Variance[b]	Total Score	50.9	14.9	--	48.5	15.0	--	--	3.30	NS
	Major Area One	51.6	15.4	--	47.5	13.9	--	TEC	9.76	.01
	Major Area Two	50.4	14.4	--	49.4	15.8	--	--	.59	NS
	Major Area Three	51.2	14.4	--	48.1	15.7	--	TEC	5.48	.05
	Major Area Four	50.1	15.1	--	49.8	14.7	--	--	.05	NS
Analysis of Covariance[c]	Total Score	49.9	14.1	50.2	48.9	14.9	48.5	--	1.49	NS
	Major Area One	51.2	14.5	51.4	48.0	13.8	47.6	TEC	7.11	.01
	Major Area Two	49.3	14.0	49.5	50.0	15.7	49.8	--	.03	NS
	Major Area Three	50.0	14.5	50.2	48.1	15.6	47.8	--	2.41	NS
	Major Area Four	49.4	14.6	49.8	50.0	14.7	49.5	--	.03	NS

[a]Adjusted means, VE held constant. These were the basis of comparison in the analysis of covariance.

[b]Analysis of variance comparisons include all tested subjects, including those for whom VE scores could not be obtained, from the 82d, 4th, 2d, 30th, and 71st. *df*s for ANOVA comparisons were 1 and 546.

[c]Analysis of covariance comparisons include only tested subjects for whom VE scores were obtained, from the 82d, 2d, 30th, and 71st. *df*s for ANOCOVA comparisons were 1 and 384.

For both the analysis of variance and the analysis of covariance (controlling for differences in VE), the TEC experimental subjects scored significantly higher in Major Area One (Individual Weapons). There was a trend toward significance for Major Area Three (Tactics), with analysis of variance results significant and analysis of covariance results not significant. However, the remaining six comparisons were not significant. This suggests that TEC lesson material was of significant utility in Major Area One, of some utility in Major Area Three, and of little utility in the remaining two areas.

[1] Subsequent analyses (see Tables 14 and 15, and Figures 1 and 2) show a substantial interaction between type of unit and the experimental variable, as measured by MOS Test scores, in both standard and raw score form. These subsequent analyses show the Active Army Control groups to outscore their corresponding TEC experimental groups in a number of comparisons, while the reverse generally was found for National Guard units. As is noted in the Discussion section, the evaluation effort probably did not identify all causes of this interactive relationship. The "All Units Combined" findings do not take this interaction into account and should consequently be interpreted with caution.

Mode of Study Data

As another way of assessing the effectiveness of the TEC lesson materials, it was possible to determine through the Mode of Study Questionnaire how many and which TEC lessons each test subject studied. Further, information from ODDLP, the Infantry School, indicated which MOS Test questions were covered by each TEC lesson. By using both sources of information together, it was possible to determine which MOS Test questions each test subject had studied for in the TEC lessons he had used. Logically, the probability of responding correctly to a question should have increased if the test subject studied a TEC lesson covering that question.

Data from the Enlisted Evaluation Center permitted an item-by-item analysis of the performance of each test subject. These individual records were hand-scored with reference to information obtained from the Mode of Study Questionnaire to obtain the number of correct answers on the test for which TEC material studied had been relevant, and the number of correct answers for which no TEC material had been studied. (All MOS Test questions were covered in the TEC lessons. However, not all test subjects studied all TEC lessons, because the amount of studying was left to the individual's option in most units. The total range of TEC lessons studied was from 1 to 55. Test subjects who had studied no TEC lessons were excluded from this analysis.)

Two percentages were then computed: (a) the percent correct of all test questions covered in TEC lessons the individual studied, and (b) the percent correct of all test questions that had not been covered in the TEC lessons studied. Both percentages were computed for each test subject in the TEC experimental group. If studying TEC lessons improved the ability of the soldier to answer MOS Test questions, the percent correct should have been higher for the questions covered by the TEC lessons he studied.

The results of this analysis are shown in Table 5. The first line in this table permits comparison of average success rate on questions covered in TEC lessons studied, with that on questions not covered. The two percentages are extremely close and the difference between them is not significant. This suggests that studying TEC lessons did not improve the soldier's chance of answering correctly those MOS Test questions covered by what he studied.

Essentially the same conclusion emerges when the men who studied more are isolated (line two of the table). Even when soldiers who studied relatively little (and thereby had few questions covered by what they studied) were excluded, studying did not significantly improve performance on those MOS Test questions covered in the material studied.

Table 5

Percentage of Correct Answers to Questions Covered and Not Covered by TEC Lessons Studied

	Studied		Not Studied				
Group	Mean	SD	Mean	SD	*df*	*t*	*p*
All[a]	54.2	19.7	54.6	14.9	196	0.31	NS
25-100[b]	54.7	13.5	53.5	12.8	90	0.94	NS

[a]This group was composed of all subjects. The range of lessons studied was from one lesson to all lessons except one.

[b]This group was composed of subjects whose studying of TEC covered 25 to 100 MOS Test Questions.

The relationship between amount studied and MOS Test performance was also examined on an individual-by-individual basis, using as measures the number of TEC lessons studied and the number of MOS Test questions prepared for by studying TEC lessons.

Correlation coefficients between two measures of amount studied, on the one hand, and VE and MOS Test total scores, on the other hand, are shown in Table 6. There were moderate but highly significant correlations between amount studied and total test score. However, there were also highly significant correlations between VE and all three of the other measures. While the amount studied thus appeared to be related to MOS Test performance, it also appeared that this linkage might be a result of the fact that both were related to VE. That is, while the more verbally adept soldiers might have been inclined to study the TEC materials more, they might have made higher MOS Test scores even if they had not studied more.

Table 6

Relationships Between Amount of Study and VE and MOS Test Total Scores, for all Subjects Combined[a]

	Questions Covered	Lessons Studied	VE
Total Score	.32**	.31**	.38***
Questions Covered		--	.39***
Lessons Studied			.39***

[a] $df = 272$; ** indicates $p < .01$, *** $p < .001$.

To test this possibility, partial correlations were run between the amount of studying done (both measures) and the MOS Test total score, with VE held constant. This partial correlation technique yields a result similar to that which would have occurred if all the test subjects had in fact had the same VE score. When VE was held constant, the relationship between the number of questions covered in the lessons studied and the MOS total score dropped from .32 to .20. While the correlation of .20 was still significant ($p<.05$), it was only about half as strong.[1] The correlation between the number of lessons studied and the MOS Test score also dropped, from .31 to .19. This also was significant ($p<.05$) but was only about half as strong.

The finding, therefore, is that soldiers with high verbal ability tended both to study TEC lessons more and to make higher MOS Test scores. This is probably because both the TEC lessons and the MOS Test required verbal aptitude. At the same time, however, the fact that amount studied was independently related to the MOS Test score shows that the TEC materials were of at least some help to soldiers taking the MOS Test beyond that mediated by verbal aptitude.

One other finding is of substantial interest. The correlation between VE and MOS Test scores was moderately high ($r = .38$) and significant ($p<.001$). When the amount of studying was partialed out of this relationship, the correlation dropped to

[1] The *strength* of a correlation drops as a function of its square. This reflects the amount of variance in common between two distributions. Thus, a correlation of .40 is four times as *strong* as a correlation of .20.

.29, which is substantially less strong though still significant ($p<.01$). This suggests two conclusions. First, VE ability is significantly correlated with performance on the MOS Test. Second, studying TEC lessons tends to *reduce* the effect of VE on MOS Test scores. That is, the MOS Test favors soldiers with higher verbal abilities, but use of the TEC materials—in these units at least—tended to reduce that bias.

The findings from this analysis conflict with the findings from the immediately preceding analysis. The present findings suggest a weak but significant relationship between the use of TEC lesson materials and performance on the MOS Test; the preceding analysis had shown no relationship. Subsequent analyses were directed at resolving this apparent contradiction.

Between-Battalion Comparisons

Correlations between measures of amount studied, on the one hand, and MOS Test total score and VE, on the other hand, are shown in Table 7 for the separate commands participating. While these correlations generally were not significant, two interesting observations can be made. First, the relationships between the amount studied and the MOS Test score were generally lower than those shown in the preceding table. Second, most of the relationships between amount studied and VE were substantially lower.

While no definitive conclusions can be drawn from these observations, the suggestion is that individual units in the TEC experimental group differed systematically in the ways they used the TEC lesson materials. This suggestion is strengthened by examination of the third column, which shows the correlation between VE score and MOS Test score. These correlations vary widely from one unit to another. This is the kind of finding that would have been obtained if units had had their own MOS Test preparation programs, in addition to TEC, and if some of these unit programs had turned out to be better than others.

Table 7

Correlations Between Amount of Study, VE, and MOS Test Total Score for Each Division/Brigade

Division/ Brigade	Measure of Amount Studied	MOS Test Score			VE Score			MOS Test Score vs. VE Score		
		r	*df*	*p*	*r*	*df*	*p*	*r*	*df*	*p*
82d	Questions Covered	+.21	134	.05	+.00	134	NS	+.32	134	.01
	Number of Lessons	+.29	134	.01	-.03	134	NS			
2d	Questions Covered	+.29	27	NS	+.34	27	NS	+.33	27	NS
	Number of Lessons	+.19	27	NS	+.25	27	NS			
4th	Questions Covered	+.21	24	NS	+.41	24	.05	+.39	24	.05
	Number of Lessons	+.25	24	NS	+.31	24	NS			
30th	Questions Covered	+.21	29	NS	+.01	29	NS	+.42	29	.05
	Number of Lessons	+.32	29	NS	+.07	29	NS			
71st[a]	Questions Covered	--	--	--	--	--	--	+.27	17	NS
	Number of Lessons	--	--	--	--	--	--			
73d	Questions Covered	+.41	31	.05	+.10	31	NS	+.59	31	.001
	Number of Lessons	+.27	31	NS	+.09	31	NS			

[a]The 71st reported 100% studying by all personnel; this unit consequently was not amenable to these analyses.

This conclusion is supported by a further analysis of overall battalion performance on the MOS Test and the average number of lessons studied per battalion. Average MOS Test total scores (standard score form) and average lessons studied are shown in Table 8 for each battalion in the TEC experimental group. There clearly is a correspondence between the average number of lessons studied in the battalion, and the battalion's average MOS Test score.

Table 8

Average MOS Test Total Score (Standard) and Average Amount Studied, by Battalion

Division/ Brigade	Battalion	Average MOS Test Score (Standard)	Average Lessons Studied	Rank	
				Standard Scores	Lessons
71st	2/143	64.0	56.0	1	1
30th	1/119	53.8	24.8	3	2
4th	2/8	55.6	23.1	2	3
	1/11	51.5	20.1	5	4
2d	2/50	53.2	9.6	4	5
	1/41	47.1	3.7	9	6
82d	2/508	51.0	2.5	6	7
	2/504	47.7	1.3	7	8.5
	2/325	47.3	1.3	8	8.5

To obtain a numerical measure of this relationship, each of these two measures was rank ordered from top to bottom, and a Spearman rank order correlation was computed. For those battalions in the active Army, the correlation was .86 ($p<.01$), which was significant. For all nine battalions shown, the correlation was .88, equally significant.

These correlations clearly indicate a strong relationship between the amount of studying of TEC lessons *by battalions as a whole*, and the battalions' performance on the MOS Test. This finding is of major importance, especially when the average number of lessons studied *by battalions as a whole* is examined. It is clear that two of the three active Army commands to which TEC lessons were available did not make full use of these materials.[1]

This could have occurred for a number of reasons. One possible reason is that these commands may have had other programs to prepare their NCOs for the MOS Test, and that these programs pre-empted the use of TEC materials. There is definite evidence from at least one command that this may have happened. Inspection of the data from individual MOS holders in that command showed that one group of low VE personnel had made high scores on the MOS Test. Unless the test had been compromised for these

[1] Examination of Tables 8 and 4 in combination shows that the average MOS Test scores for pooled RA personnel were determined primarily by the results from one Division, in which frequency of use was quite low. It consequently is reasonable to question the generalizability of findings within RA units as to TEC effectiveness.

soldiers—and there is no reason to believe that happened—the only possible explanation is that the command conducted compulsory unit schools for low ability MOS holders.

However, this situation was found in only one command. Data from the remaining commands suggest that in some units there simply was less command emphasis on preparing for the test. So the explanation for the findings reported thus far may need to take into account only these two factors: First, it is highly likely that some units had a planned preparation for the MOS Test, which may or may not have been compulsory. In either case, it may have pre-empted use of the TEC materials. Where this unit preparation was ineffective, performance on the test suffered. Second, command emphasis on preparing for the test probably varied. The TEC materials were probably used to maximum advantage in battalions where command emphasis on the MOS Test was high, and where either there were no competing programs or these programs did not pre-empt use of TEC materials. *When the reported use of TEC lessons was high, unit performance on the MOS Test was high.*

This conclusion is supported by a comparison of TEC experimental and Control units within divisions/brigades. Raw and adjusted (except for the 4th Division) averages on the MOS Test, are shown in Tables 9 through 13, which also indicate when differences between experimentals and controls were significant.

There appears to be no obvious rational basis for the patterns found in the data. On the one hand, Control battalions in the 82d Division were higher in all five comparisons than the TEC experimental battalions, and significantly so in four. In contrast, TEC experimental and Control battalions in the 2d Division were virtually identical in all comparisons except for Major Area Three, for which the TEC experimentals were marginally higher. In the 4th Division, all comparisons favored TEC experimentals, and three were significant. In the 30th Division, again, differences were small and nonsignificant. However, in the 71st Brigade, differences favoring the TEC experimentals were massive and uniformly significant at a very high level.

Examination of these tables in relation to Table 8 suggests a rational way of viewing these apparently irrational differences. First, in those units in which comparisons tended to favor controls or in which there were nonsignificant differences, Table 8 shows that utilization of TEC lessons was also low. For those commands in which comparisons favored TEC, utilization of TEC was high. Further, average performance on the MOS Test also tended to be high for these units.

Table 9

Summary Data for TEC Experimental and Control Group Performance on the MOS Test Areas for 82d Division

MOS Test Area	Group						High Group[a]	*F* ratio[b]	*P*
	TEC Experimental			Control					
	Mean	SD	Adjusted Mean	Mean	SD	Adjusted Mean			
Total	69.2	13.5	69.0	75.8	14.8	76.4	C	10.69	.01
Major Area One	14.7	3.4	14.6	15.2	3.7	15.3	–	1.19	NS
Major Area Two	15.5	4.0	15.5	17.6	4.2	17.7	C	11.13	.001
Major Area Three	16.3	3.9	16.2	17.7	4.4	17.8	C	5.62	.05
Major Area Four	22.7	5.4	22.7	25.3	4.9	25.5	C	11.54	.001

[a]Group with the highest mean when the *F* ratio was significant ($p < .05$).
[b]*F* ratios from the analysis of covariance.

Table 10

Summary Data for TEC Experimental and Control Group Performance on the MOS Test Areas for 2d Division

MOS Test Area	Group						High Group[a]	*F* ratio[b]	*p*
	TEC Experimental			Control					
	Mean	SD	Adjusted Mean	Mean	SD	Adjusted Mean			
Total	63.8	13.1	63.9	63.2	10.9	63.2	--	0.06	NS
Major Area One	13.3	4.1	13.3	12.2	3.6	12.2	--	1.26	NS
Major Area Two	14.1	3.4	14.1	14.7	3.8	14.7	--	0.33	NS
Major Area Three	15.1	3.7	15.1	13.9	2.9	13.9	--	1.92	NS
Major Area Four	21.3	4.8	21.3	22.5	4.1	22.4	--	1.21	NS

[a]Group with the highest mean when the *F* ratio was significant ($p < .05$).

[b]*F* ratios from the analysis of covariance.

Table 11

Summary Data for TEC Experimental and Control Group Performance on the MOS Test Areas for 4th Division

MOS Test Area	Group				High Group[a]	*F* ratio[b]	*p*
	TEC Experimental		Control				
	Mean	SD	Mean	SD			
Total	71.6	12.0	62.3	14.1	TEC	6.85	.05
Major Area One	14.4	3.8	12.2	3.0	TEC	5.20	.05
Major Area Two	16.7	3.4	13.2	3.9	TEC	12.34	.01
Major Area Three	16.9	3.0	15.6	4.4	--	1.45	NS
Major Area Four	23.7	5.0	21.3	5.2	--	2.93	NS

[a]Group with the highest mean when the *F* ratio was significant ($p < .05$).

[b]*F* ratios from the analysis of covariance.

The extreme case is that of the 71st Brigade, where use of TEC lessons was mandatory, and all NCOs took all lessons *en masse*. The overall performance of the TEC experimentals in the 71st Brigade was sharply higher than that of Controls in the 71st, and also sharply higher than that of most of the Active Army units, whether TEC experimental or Control.

Again, it appears that the major variable is degree of use of TEC lessons. Where TEC was used, unit performance on the MOS Test was higher. Massive use, as in the 71st Brigade, produced massively improved performance.

Table 12

Summary Data for TEC Experimental and Control Group Performance on the MOS Test Areas for 30th Division

MOS Test Area	Group						High Group[a]	*F* ratio[b]	*p*
	TEC Experimental			Control					
	Mean	SD	Adjusted Mean	Mean	SD	Adjusted Mean			
Total	59.4	8.3	58.9	56.3	12.3	56.5	--	1.00	NS
Major Area One	11.6	3.2	12.6	12.8	3.4	11.7	--	1.75	NS
Major Area Two	12.4	3.3	12.6	12.7	2.5	12.4	--	0.07	NS
Major Area Three	13.1	3.8	14.3	14.3	2.6	13.1	--	2.21	NS
Major Area Four	19.7	3.6	19.4	19.2	5.3	19.3	--	0.02	NS

[a]Group with the highest mean when the *F* ratio was significant ($p < .05$).
[b]*F* ratios from the analysis of covariance.

Table 13

Summary Data for TEC Experimental and Control Group Performance on the MOS Test Areas for 71st Brigade

MOS Test Area	Group						High Group[a]	*F* ratio[b]	*p*
	TEC Experimental			Control					
	Mean	SD	Adjusted Mean	Mean	SD	Adjusted Mean			
Total	81.0	6.2	81.2	62.9	11.7	62.8	TEC	46.81	.001
Major Area One	17.5	1.2	17.5	13.2	2.7	13.2	TEC	52.46	.001
Major Area Two	18.1	1.9	18.2	14.0	3.5	13.9	TEC	27.46	.001
Major Area Three	19.1	3.0	19.1	14.8	3.7	14.8	TEC	19.61	.001
Major Area Four	26.3	3.2	26.4	20.9	4.6	20.9	TEC	24.20	.001

[a]Group with the highest mean when the *F* ratio was significant ($p < .05$).
[b]*F* ratios from the analysis of covariance.

Active Army and National Guard Comparisons

The preceding analyses have shown wide differences in the extent to which the various TEC experimental battalions used and profited from the TEC lesson materials. The tentative conclusion drawn was that the extent of use of TEC materials was the central variable determining TEC experimental unit performance on the MOS Test, when VE was controlled. However, the alternate possibility raised was that some of the units might have had competing MOS preparation programs that pre-empted time available for use of TEC.

It appeared that a useful further comparison to throw light on this question would be between Active Army and National Guard units. The Board for Dynamic Training

Survey had shown the training support needs of the National Guard to be more serious than those of the Active Army, so National Guard units should theoretically have fewer "competing" programs.

Comparisons were made between TEC experimental and Control groups within Active Army units only, and within National Guard units only. Results of this comparison are shown in Figure 1 and Table 14. As was done previously, analysis of covariance was used to control VE, and the averages shown in Figure 1 have been adjusted to eliminate the influence of VE. Examination of this Figure shows that National Guard units in the TEC experimental group performed strikingly better on the MOS Test than National Guard Control units. Reference to Table 14 shows that these differences were all highly significant.

However, Active Army units present a strong contrast. In all five comparisons (total score and four major area scores), the TEC experimental units performed worse than their Controls. Three of these five differences were significant.

Figure 1 shows one additional finding that is equally striking. In four of the five comparisons, the National Guard units with TEC outscored Active Army units of both types (TEC experimental and Control).

The preceding comparisons involved standard adjusted mean scores; that is, VE ability was controlled in computing the scores. To determine whether this control made a major difference, similar comparisons were made on standard scores without the VE control. These results are shown in Table 15 and Figure 2. (Data from the 4th Division were also added for these comparisons; the 4th Division was not included in the previous comparisons because of missing VE data.)

These data yield conclusions similar to the previous data, except that the superiority of the National Guard TEC users was even more pronounced, in comparison with other National Guard units or Active Army units.

FACTORS INFLUENCING EVALUATION OUTCOMES

While it was concluded in the preceding section that a major variable influencing MOS Test outcomes was the degree of TEC use, it seems appropriate to try to identify any additional influences on test outcomes. An explanation for the direct contradictions in the first two sets of findings seemed especially desirable: One finding showed virtually no effect from studying TEC lessons; the other showed positive effects.

Two possible variables which have not been considered thus far but which might have had an impact on the findings obtained are:

(1) TEC lesson quality. The evaluation effort did not attempt to assess TEC lesson quality. However, since the materials were prepared under the most stringent time pressures, it would seem likely that some lessons might have been better than others. Further, some lessons may have been better designed to cover critical material than others.

(2) Quality of questions on MOS Test, both in total and by Major Areas. These questions were prepared initially at the Infantry School under similarly great time pressure. One possibility is that some questions were "less good" than others. A second possibility is that the TEC lessons covered some of the questions more or less well—or more or less intensively.

These two variables were explored in depth to determine the extent to which they may have affected the evaluation findings. Two sources of information were available for this exploration—the outline of TEC lessons, and the ODDLP list of questions by TEC lesson.

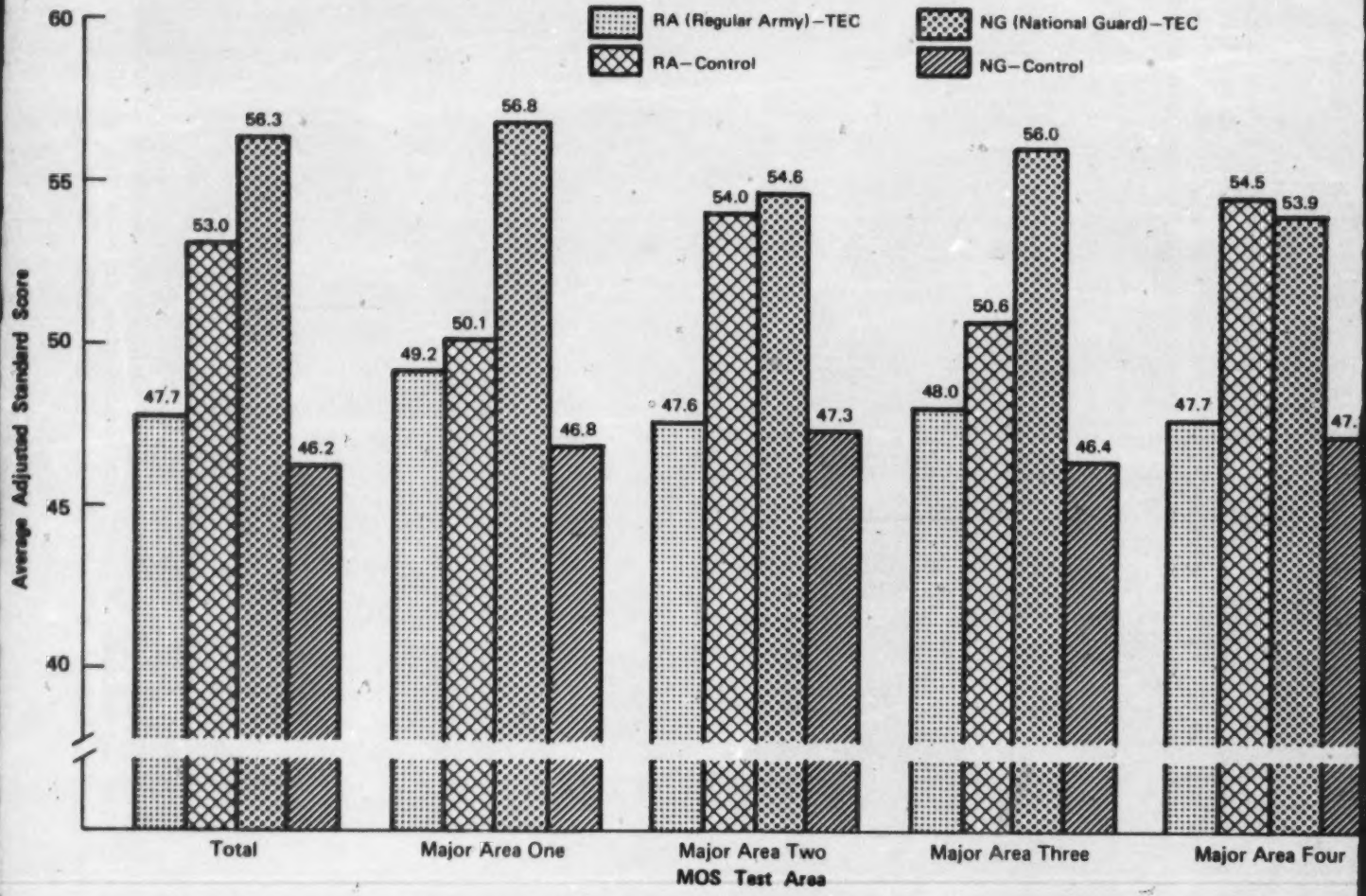


Figure 1. Average Adjusted Standard Scores of Active Army and National Guard Groups for MOS Test Areas, With VE Controlled

Table 14

Summary of Analyses of Covariance for Active Army and National Guard Groups for MOS Test Areas

MOS 11B40 ET Area	Comparison	*F* ratio[a]	*p*
Total	RA – TEC vs RA – C	7.95	.01
	NG – TEC vs NG – C	19.20	.001
Major Area One	RA – TEC vs RA – C	.20	NS
	NG – TEC vs NG – C	21.99	.001
Major Area Two	RA – TEC vs RA – C	10.58	.01
	NG – TEC vs NG – C	8.43	.01
Major Area Three	RA – TEC vs RA – C	1.59	NS
	NG – TEC vs NG – C	14.25	.001
Major Area Four	RA – TEC vs RA – C	13.34	.001
	NG – TEC vs NG – C	8.31	.01

[a]*df* for RA (Regular Army) comparisons were 1 and 236; *df* for NG (National Guard) comparisons were 1 and 145.

Table 15

Summary of Analyses of Variance for Active Army and National Guard Groups for MOS Test Areas

MOS 11B40 ET Area	Comparison	*F* ratio[a]	*p*
Total	RA – TEC vs RA – C	0.68	NS
	NG – TEC vs NG – C	24.71	.001
Major Area One	RA – TEC vs RA – C	0.75	NS
	NG – TEC vs NG – C	24.09	.001
Major Area Two	RA – TEC vs RA – C	1.62	NS
	NG – TEC vs NG – C	11.66	.001
Major Area Three	RA – TEC vs RA – C	0.09	NS
	NG – TEC vs NG – C	17.44	.001
Major Area Four	RA – TEC vs RA – C	4.21	.05
	NG – TEC vs NG – C	12.56	.001

[a]*df* for RA (Regular Army) comparisons were 1 and 387; *df* for NG (National Guard) comparisons were 1 and 157.

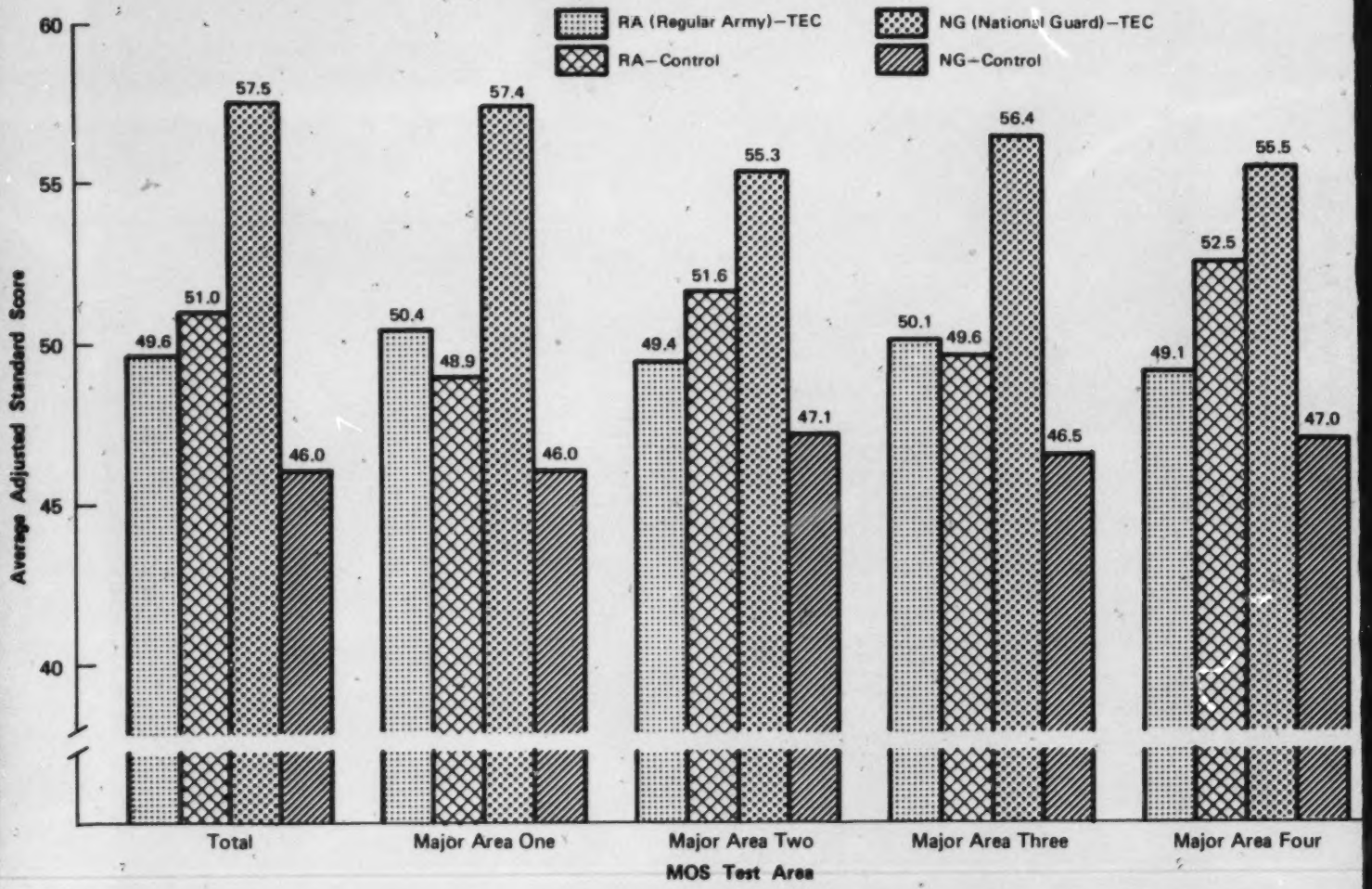


Figure 2. **Average Adjusted Standard Scores of Active Army and National Guard Groups for MOS Test Areas, Without VE Controlled**

TEC lesson coverage of major areas and total test is shown in Table 16, which measures two items. One is how well the TEC lessons in a given major area covered the MOS Test questions in that area. From this the efficiency of TEC lesson design can be inferred. The second item is how well MOS Test questions were covered by TEC lessons. From this, it is possible to infer whether TEC left soldiers unprepared in some areas.

Table 16

Relationship Between TEC Lessons and MOS Test Questions

MOS 11B40 Major Area	Source of Defining Relationship Between TEC Lessons and Test Questions					
	Original TEC Lesson Outline					ODDLP
	Number of TEC Lessons	Number of TEC Lessons Covered by Test Questions	Percentage of MOS Questions Covered by TEC Lessons[a]	Range of Questions Covered Per Lesson		TEC Lessons Covered by Questions[b]
				Low	High	
1	7	7	22.4 (22.4)	3	6	7
2	6	4	16.0 (21.6)	0	8	6 (4)
3	21	13	41.6[c] (24.0)	0	11	8 (6)
4	22	10	20.0 (30.0)	0	6	16 (14)
Total	56	34	100.0 (100.0)	0	11	34

[a]Parenthesized number is the percentage of all MOS Test questions pertinent to that area.

[b]Parenthesized number is the number of TEC lessons unique to that major area. The remaining lessons shown for that area covered other areas as well.

[c]Part of the questions related to these TEC lessons were in other areas.

In general, some areas were shown to be handled more effectively and efficiently by TEC lessons than others. Major Area One was the only one with an exact parallel between TEC lessons and MOS Test questions. Seven TEC lessons were found in Area One, and all seven were relevant to the test. Further, examination of the range of questions per lesson shows that the relevance of each individual lesson was high. No lesson was relevant to less than three MOS Test questions.

Examination of data for the other three areas shows a less successful situation. Areas Two and Four lacked complete coverage of the test; that is, some questions in each of those areas were not covered by the supposedly relevant TEC lessons. Further, the efficiency of coverage was uneven. At least one lesson in each area was not relevant to any questions in that area. (The ODDLP outline suggests that there were two such lessons for Major Area Two, and two for Major Area Four.)

Finally, Major Area Three combined two types of deficiencies. In addition to lessons that were not relevant to MOS Test questions, some lessons were relevant to questions in other major areas. Also, the efficiency of coverage was *extremely* uneven, with as many as 11 questions covered in a single lesson.

DISCUSSION

EVALUATION RESULTS

The findings from evaluation of the TEC materials are not all positive. For example, it was found that studying TEC lessons which covered specific MOS Test questions did not significantly improve the chance of answering those questions correctly. Further, when all test soldiers are combined, those in TEC experimental units did not do significantly better than Control subjects in most of the comparisons made.

However, when data are examined at a unit level, strong support for the effectiveness of the TEC concept emerges. The amount of studying done, as measured by the number of lessons studied, was strongly related to unit performance on the MOS Test. The one battalion which gave massive emphasis to study of TEC lessons performed much more effectively on the MOS Test, as a unit, than did any other. This finding is all the more striking when one considers that the unit in question was a National Guard unit, whose 11B40 MOS holders presumably have less opportunity to practice the operating skills of that MOS than their 11B40 counterparts in Active Army units. Nonetheless, 11B40 MOS holders in this National Guard battalion were qualitatively superior on the MOS Test to tested soldiers, even to those in Active Army units. This finding holds true whether verbal ability differences are held constant or not.

PROBLEMS NOTED

Analysis of the findings did not permit identification of reasons why there were some inconsistencies in the analysis results. However, several inferences can be drawn.

(1) The conditions of administration of TEC materials almost certainly differed in major ways from unit to unit. At one extreme was the National Guard unit referenced earlier, in which MOS holders were required to attend all TEC lessons. At the other extreme is one Active Army division, in which there probably was some sort of refresher training for 11B40 MOS holders. Because the number of TEC lessons studied in that division was so low, on the average, it is probable either that there was no command emphasis on use of the TEC materials in that division, or that unit programs (or possibly other priorities) competed for soldiers' time. Thus, the *presence* of TEC materials was not sufficient. Commitment by the unit to their use seems essential to the effectiveness of instructional innovations such as TEC. While this is not a startling finding, it demonstrates that superior instructional resources will be of no value to units in the field unless commanders give them sufficient priority to insure that soldiers who need them will in fact use them.

(2) The materials themselves were found to be another major problem with the TEC evaluation; particular problem areas concerned the evenness of coverage of MOS Test items by TEC lessons, and the relevance of each TEC lesson to the test. Ideally, one would like to have all available TEC lessons covered by MOS 11B40 Evaluation Test questions and an even distribution of questions over lessons. That is, all TEC lessons should have been pertinent to the test, and relevant to roughly the same number of questions each. This ideal situation occurred only in Major Area One, which, in terms of acquisition of knowledge and measurement of knowledge, provided the only reasonably sensitive test of the effectiveness of the TEC concept. Interestingly enough, in the analysis of evaluation data, this area provided clearcut evidence of the effectiveness of that concept.

ADEQUACY OF TEC LESSON CONTENT

The questions of non-coverage and uneven coverage have been raised not only because such failings will in themselves decrease learning, but also because they are symptomatic of possibly even more serious deficiencies. The observed problems of efficiency and coverage raise a question concerning the adequacy of the *content* of the TEC lessons themselves.

Ideally, the development of instructional material follows certain set steps, which are both logical and necessary if the instruction is to be efficient and effective. (The CONARC Systems Engineering Regulation[1] closely parallels these steps.) In broad outline, it is necessary to analyze the job itself, determine the performance requirements for the job, develop training with terminal performance objectives that match those requirements, develop a job-oriented terminal performance test to see whether the objectives have been met, and then test course graduates. This suggests that there should be complete overlap between what the student is tested on and his instruction (though the test obviously cannot contain within reasonable time limits everything the student must do on the job).

END-OF-COURSE TESTING

The solution to the problem of inadequate time for end-of-course testing may take one or both of two forms. One is to have a pool of performance items from which samples are drawn to develop the end-of-course test for *each set* of graduates. While this procedure will not test each student on each part of his job, it will give each graduating class an equal chance of being tested on any given performance item in the job, and is thus a "fair" test. The second procedure is to "modularize" the instruction, i.e., develop logical "packages" of content, each of which can stand on its own. After completion of each module, the student can be tested on the performances covered by that module. Such testing is the basis for proficiency-based advancement through instruction and is the tool that permits implementation of that important training concept. Such intermediate testing also permits diagnosis of student weaknesses, identification of modules that might not be performing as well as they should, and recycling over *short* segments of a course rather than *long* segments.

In either case, the instruction must be based on the requirements of the job (as must also the test), and the test must measure fairly what has been taught. That these requirements have not been met in the TEC lesson material is obvious from the findings. There was neither efficient coverage of the entire test nor complete relevance to the test; and there is no clear evidence that the test was based exclusively on job performance requirements. Further, there was only rudimentary "modularization," and even that was not effective. Finally, there was no concept of end-of-module skill or performance testing to serve diagnoistic or feedback functions. (It should be noted that there has been no analysis of the essentiality of specific content within individual TEC lessons. However, when the gross errors thus far mentioned occur, it is likely that extraneous material will also occur within the instructional material for individual lessons. This is "nice-to-know" material in some cases. In other cases it may simply be material that looks and sounds good, but in fact is irrelevant to the performance being taught.)

[1] U.S. Continental Army Command. *Systems Engineering of Training (Course Design)*, CONARC Reg. No. 350-100-1, 1972.

ANALYSIS OF TEC EFFECTIVENESS

The foregoing sounds critical, and in fact is. On the other hand, it is difficult to see how the materials were as effective as they were, given the heavy time pressure and inadequate personnel resources that characterized the development of the TEC materials and the MOS Test questions. In these circumstances, *any* indication of effectiveness of the TEC concept takes on added meaning. *The point is, however, that it is extremely difficult to see how the TEC concept can be fairly tested when the test vehicle itself is subject to quality problems.*

In the absence of further investigation, it should be concluded that the TEC concept demonstrated its effectiveness, given a command climate favorable to its use. There is also some basis for stating that TEC is more effective than the existing unit programs for MOS Test preparation. It will be recalled that there was a high relationship between the average amount of studying within battalions, and the battalion average performance on the MOS Test. Standard scores were used for this determination, which means that average MOS Test performance was *with reference to Control battalions in the same division/brigade.* This means that greater average use of TEC materials increased the relative advantage of TEC users over non-TEC users, *within divisions/brigades.*

GUIDES TO TEC IMPROVEMENT

This evaluation also permits the generation of guidance for making TEC more effective in future applications. Some specific points are:

(1) TEC materials probably require some form of command emphasis for their most effective utilization within units. This is so for a variety of reasons. First, to develop superior effectiveness, the individual soldier probably must be motivated by some anticipation that the commander wants it, and will think better of him for improving himself. TEC is a way of obtaining *standardized* improvement in individual effectiveness at the level of the individual soldier. However, the attainment of *effectiveness standardization* is an obvious impossibility under a *laissez-faire* policy concerning use of the materials. TEC therefore needs to be integrated into a conscious unit atmosphere of interest and concern for effectiveness and improvement at the level of the individual MOS holder. The soldier needs to know that his seniors are aware of his knowledge and skill deficiencies, have the means to help him improve himself, and will think more highly of him as a soldier if he spends the time and effort to improve.

(2) Future TEC materials should be carefully systems-engineered. TEC will not always be relevant to an MOS Proficiency Test. TEC was relevant in the present evaluation because the MOS Test served as a convenient evaluation vehicle to make it so. Whenever TEC materials are developed, they should be designed to accomplish a job-relevant purpose. Each lesson should be designed around specific performance objectives and pretested to ensure that these objectives can be met by soldiers who take the TEC lesson. Lessons that do not produce the projected learning should be redone. Tests against which the lessons are measured should be performance-based, to ensure that the lessons themselves are job-relevant.

(3) When several TEC lessons are relevant to the same content area, attention should be given to sequencing the objectives trained, to achieve the best learning sequence for efficiency and effectiveness. That is, some learning sequences, depending on the nature of what is being taught, are more effective and efficient than others, and should be used. Further, the content should be modularized to the extent possible.

(4) Guidebooks should be developed for unit trainers, indicating the rationale behind the particular sequencing of content in TEC lessons, and giving instructions for testing to determine when modules have been mastered. Instructions should also be included for recycling the lessons for optimum efficiency, based on diagnosis of student weaknesses and student progress.

APPENDICES

Appendix A

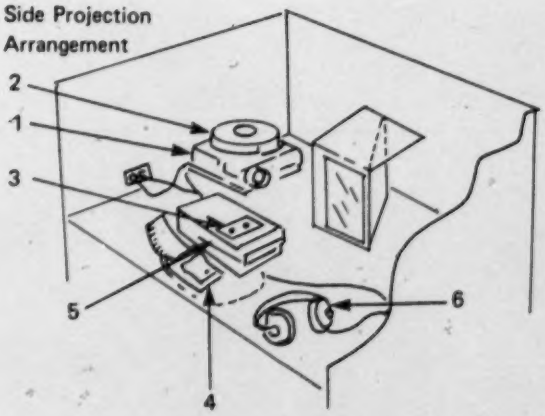
INDIVIDUAL LEARNING CARREL

When the student uses the individual learning carrel, the projector can be used for either side projection or front projection. The illustrations show usable arrangements for the equipment, which includes:

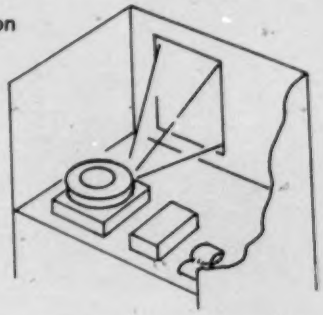
- Projector (1)
- Cassette recorder (5)
- Responder (4)
- Headset (6)
- Slide tray (2) and tape cassette (3) program
- Equipment connecting cables

For front projection, white cardboard or bond paper may be used as the projection screen.

Side Projection Arrangement



Front Projection Arrangement

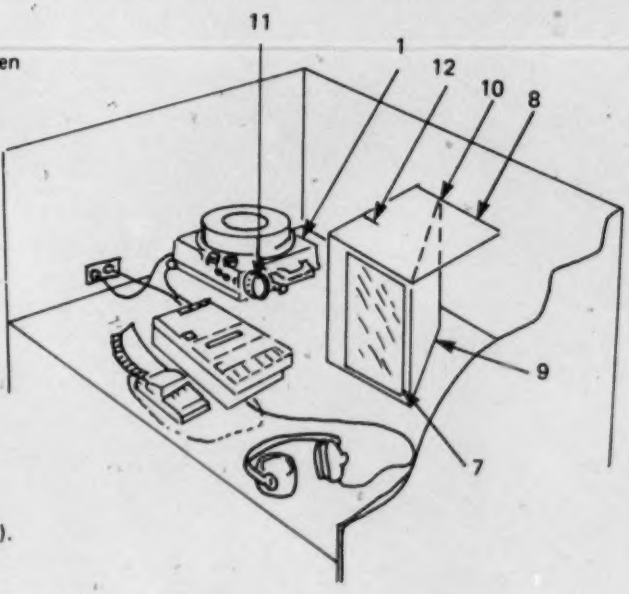


If using the side projection arrangement, perform Steps A through C to set up the screen in the learning carrel.

A. Open the screen unit and place it in the learning carrel so that the screen (7) will face the student. Allow room for the projector (1) to the left of the screen.

B. Lift up the cover (8) and let it rest on the mirror (9). Align the mirror with the arrow marked MIRROR (10) on the cover. If the screen is to be a permanent fixture, the mirror may be secured to the cover to prevent angle changes.

C. Position the projector (1) so its lens (11) is pointing at the center of the mirror (9) and is aligned with the arrow marked PROJECTION LENS (12) on the cover (8).



Appendix B

TEC LESSONS AVAILABLE TO THE UNITS DURING THE TEST PERIOD

Major Area	Lesson Number	Title of TEC Lesson
Individual Weapons	000/001	M16A1 Rifle
	002	M72A2 LAW
	003	Night Vision Devices
	004	M203/M-79 Grenade Launcher
	005	Grenades
	006	Flamethrower
	007	M18A1 Claymore
Crew-Served Weapons	021	M60 Machinegun
	022	Technique of Fire
	023	Adjustment of Indirect Fire
	024	Caliber .50 Machinegun
	025	90mm Recoilless Rifle
	026	Mine Warfare
Tactics (Squad)	041	Fundamentals of Offense
	042	Combat Formations and Battle Drill
	043	Rifle Squad in the Attack
	044	Mech Inf Combat Formations and Battle Drill
	045	Mechanized Infantry in Attack (Squad)
	046	Small Unit Techniques
	047	Squad Defensive Operations
	049	Mechanized Inf in the Defense
	050	Retrograde Operations
	051	Combat in Built-Up and Fortified Areas (Squad)
	052	Airmobile Operations
	053	Antiarmor Operations
	054	Field Fortifications
	055	Camouflage
	056	Obstacles
	057	Demolitions
	058	Stream Crossing Techniques
	059	CBR and Nuclear Defense
	060	Planning and Preparation for a Patrol
	061	Conduct of Patrols
	062	Individual Patrolling Techniques
Field Activities	091	Intelligence and Counterintelligence
	092	Basic Military Justice
	093	Law of Land Warfare

(Continued)

Major Area	Lesson Number	Title of TEC Lesson
Field Activities *(Cont.)*	094	Lesson Planning
	095	Fundamentals of Instruction
	096	Training Aids
	098	Drill
	100	Physical Conditioning
	101	Map Reading and Land Navigation
	106	Emergency Medical Care
	107	Field Sanitation and Hygiene
	108	Infantry Company Commo Equipment
	109	Inf Company Commo Systems
	110	SOI/SSI/COMSEC/EW
	111	Radiotelephone Procedure
	113	Maintenance Related Supervisory Responsibilities
	114	Preventive Maintenance
	115	Equipment Serviceability Criteria
	116	Self Recovery Techniques
	117	Fundamentals of Leadership
	118	Counseling
	119	Leadership Problems

Appendix C

MODE OF STUDY QUESTIONNAIRE

MODE OF STUDY

UTEC LESSON QUESTIONNAIRE

UT-B- _____
(write in number)

This questionnaire is to be completed by MOS 11B40 personnel only.

Each time you study this lesson, please complete the form below and return it to your unit UTEC Project Officer.

Name _____ Date _____
Last First MI

Unit _____ SSAN _____

1. Did you study this lesson: (Check One)

   ☐ By yourself? ☐ In a small group? ☐ With your unit?

2. Did you study during duty hours?

   ☐ Yes. ☐ No.

3. Was study voluntary?

   ☐ Yes. ☐ No.

4. Was this the ☐ 1st, ☐ 2d, ☐ 3d, ☐ 4th time you studied the lesson?

5. How much time did you spend on this lesson this time? _____

COMPLETED FORM SHOULD BE TURNED IN WITH LEARNING CENTER MATERIAL